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Who takes risks in high-risk sport? The role of Alexithymia

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Abstract

People who have difficulty identifying and describing their emotions are more likely to seek out the experience of emotions in the high-risk domain. This is because the high-risk domain provides the experience of more easily identifiable emotions (e.g., fear). However, the continued search for intense emotion may lead such individuals to take further risks within this domain, which in turn would lead to a greater likelihood of experiencing accidents. Across three studies, we provide the first evidence in support of this view. In Study 1 (n = 762) alexithymia was associated with greater risk taking and a greater propensity to experience accidents and close calls. In Study 2 (n = 332) and Study 3 (n = 356) additional bootstrapped mediation models confirmed these relationships. The predictive role of alexithymia remained significant when controlling for sensation seeking (Study 1) and anhedonia (Study 2 and Study 3). We discuss the practical implications of the present model as they pertain to minimizing accidents and close calls in the high risk domain.

Who takes risks in high-risk sport? The role of alexithymia

Fear… and the state between survival and death are such strong experiences that we want them again and again. We become addicted. Strangely, we strive to come back safely and being back, we seek to return, once more, to danger. *Reinhold Messner*
(Coffey, 2005, p. 7)

There is currently a lack of consensus regarding a suitable descriptive moniker for sports that include skydiving, rock climbing, and white water kayaking. Indeed, such sports have been labeled as *adventure, alternative, extreme, lifestyle* or *risk-taking* (e.g., Brymer, 2010; Castanier, Le Scanff, & Woodman, 2011; Kerr & Houge Mackenzie, 2012; West & Allin, 2010). For the purpose of this research, we choose the term "high-risk sport" which is defined as "all sports where you have to reckon with the possibility of serious injury or death as an inherent part of the activity" (Breivik, 1999, p. 10). Of note is that such activities can be performed in environments where the danger is viewed as relatively sanitized (e.g., Grade 1 kayaking) but the sport itself would still be considered high-risk, as the person who progresses within that sport will progress toward greater danger (e.g., more dangerous rivers such as Grade 3 and beyond).

Recent research demonstrates that one participatory goal for certain high-risk sport participants, be it conscious or not, is to experience and to enhance a sense of emotion regulation in everyday life (Barlow, Woodman, & Hardy, 2013; Woodman, Cazenave, & Le Scanff, 2008). Emotion regulation is the term used to characterize the diverse processes involved in initiating, maintaining, and modulating the intensity, type, or duration of emotions (Gross & Thompson, 2007; Thompson, 1994). Emotion regulation refers to actions that influence "which emotions we have, when we have them, and how we experience and express them" (Gross, 2002, p. 282). A growing body of research has provided evidence that participation in high-risk sport reflects a means of emotion self-regulation (Barlow et al., 2013; Cazenave, Le Scanff, & Woodman, 2007; Levenson, 1990; Shapiro, Siegel, Scovill, &

Hays, 1998; Taylor & Hamilton, 1997; Woodman et al., 2008; Woodman, Hardy, Barlow, & Le Scanff, 2010; Woodman, Huggins, Le Scanff, & Cazenave, 2009).

Risk taking in high-risk sport. Individual differences exist in how participants approach, control, and modulate the risks that are inherent within the high-risk sport domain (Barlow et al., 2013; Castanier, Le Scanff, & Woodman, 2010b; Taylor, Gould, Hardy, & Woodman, 2006). For example, Woodman et al. (2013) demonstrated that high-risk sport participants might engage in *precautionary behaviors* in order to minimize risk and/or might maximize their exposure to risk via *deliberate risk taking* behaviors (see also Paquette, Lacourse, & Bergeron, 2009). Emotion regulation, a foundation of the present study, appears to be a fruitful framework from which to understand the motives for adopting differing risk taking behaviors (Castanier, Le Scanff, & Woodman, 2010a).

Alexithymia. A specific emotion regulation difficulty that is of particular theoretical interest in relation to risk taking behaviors is Alexithymia; a stable trait (Luminet, Rokbani, Ogez, & Jadoulle, 2007) that is characterized by difficulties in differentiating one's feelings and expressing them in words (Taylor, Bagby, & Parker, 1999). Alexithymic individuals can appear to lack feelings altogether because of their inability to express their emotions and their difficulty in understanding or realizing their own emotions. Furthermore, alexithymic people's inability to interpret their own emotional signals can often have a profoundly disruptive effect on their personal lives, with poor emotional communication frequently hampering interpersonal relationships (Taylor et al., 1999). For individuals with emotion regulation difficulties, there are broadly two different options: The first is that they might let their emotion regulation difficulties take hold and thus adopt destructive behavior patterns or reach a stage of clinical depression (Pierson, Le Houezec, Fossaert, Dubal, & Jouvent, 1999). For example, high levels of alexithymia are associated with substance abuse and alcohol dependency (e.g., Loas, Otmani, Lecercle, & Jouvent, 2000). The second option is for the

alexithymic individual to react by pursuing more adaptive behaviors as a compensatory strategy (Pierson et al., 1999; Taylor & Hamilton, 1997). Indeed, high-risk sport has been shown to be an attractive and effective compensatory strategy for the alexithymic individual (Woodman et al., 2008).

The alexithymic individual's difficulty with the experience and interpretation of emotion is such that the source, valence, and intensity of emotions evoked in everyday life may be confusing and unclear (Cisler, Olatunji, Feldner, & Forsyth, 2010). In other words, in everyday life, alexithymic people are unable to identify the specific origin of their emotion, express it, or control it effectively (Woodman et al., 2010). A specific attraction of the high-risk domain is that it enables such individuals to move from experiencing non-specific, ambiguous and internal emotions (e.g., anxiety) to experiencing specific and intense emotions (e.g., fear), which are attached to an objective danger (cf. Castanier et al., 2011; Fenichel, 1939; Sadock & Sadock, 2007). Such an emotional experience may be particularly attractive to the alexithymic individual because emotions concerned with externalized relatively objective threats are more readily identifiable and require explicit emotion regulation (Gyurak, Gross, & Etkin, 2011; Koole & Rothermund, 2011). Thus, alexithymic people may experience emotion in the high-risk domain in a way that is perceived as not readily available to them in everyday life (Woodman et al., 2010). For example, Dean Potter[1], whose rock climbing, BASE jumping, and high-lining accomplishments have become some of the most celebrated of their kind in the extreme sports community, stated, "I just want emotions rushing through me that normally aren't there in everyday life . . . the feeling totally overwhelms me… I wish I could find that without risking my life but right now it's the only way I know how to find it" (Potter & Soldinger, 2010).

[1] We are not suggesting that Dean Potter is an alexithymic individual.

Emotional acclimatization. The emotional experience of the high-risk domain may be so attractive to the alexithymic individual that the desire to repeat the experience becomes somewhat addictive (cf. Franken, Zijlstra, & Muris, 2006). However, simply repeating the same high-risk activity will, over time, reduce the engendered intensity of the emotional experience of participating (Franken et al., 2006; Pierson et al., 1999) and consequently likely diminish the emotion regulation benefit to the alexithymic individual. Specifically, the emotion regulation benefit is a consequence of experiencing distinct, unambiguous, intense emotion: the type that is perceived as not being readily available in everyday life. If the engendered emotion (of the high-risk domain) becomes normative, and thus by definition does not significantly differ from that experienced in everyday life, the (emotion regulation) benefit will be lost (Solomon, 1980). Such an emotional-acclimatization cycle is similar to that of the pharmacological-acclimatization experienced by the substance abuser. Namely, when frequently administered, the hedonic value of drugs (e.g., cocaine) is decreased as the user's reward set-point shifts in order to maintain physiological homeostasis (Ahmed & Koob, 1998). Thus, to gain a renewed 'high' the drug user must increase the dose of the drug and, as a consequence, increase the associated risk of the drug taking behavior (Franken et al., 2006).

Maintaining emotional intensity. In order to maintain an ongoing emotion regulation benefit of participation, the alexithymic individual will likely seek out a continued sense of emotional intensity during participation as a means of experiencing the distinct identifiable emotions associated with engagement (e.g., fear). One way that emotional intensity can be influenced is via an individual's specific attitude to risk *within* the high-risk domain. Indeed, attitudes to risk *within* the high-risk domain have been shown to vary considerably (Woodman et al., 2013). Specifically, many high-risk sport participants engage with the express desire to minimize and control the dangers inherent in the high-risk domain

by exhibiting *precautionary behaviors* (e.g., Pain & Pain, 2005). Indeed, *mastery* (e.g., Slanger & Rudestam, 1997), *flow* (e.g., Houge Mackenzie, Hodge, & Boyes, 2011) and a sense of control over the dangers inherent in the high-risk domain (Barlow et al., 2013) may be a central motive for certain high-risk sport participants' engagement with their activity. Conversely, other participants "view risk as desirable rather than a thing to be minimized" (Celsi, Rose, & Leigh, 1993, p. 16). Such individuals appear purposefully to increase their exposure to danger by engaging deliberately in additional risk taking behaviors whilst participating in high-risk sport (e.g., Llewellyn & Sanchez, 2008; Slanger & Rudestam, 1997; Woodman et al., 2013). An example of such behavior is a mountaineer who purposefully ascends a snow gully despite the existence of a less dangerous alternate route and in the knowledge that the chosen snow gully has a known high probability of avalanche.

According to the present theoretical framework, high-risk sport participants with alexithymic tendencies will engage in *deliberate risk taking behaviors* and minimize *precautionary behaviors* with the aim of experiencing emotional intensity from their participation. Indeed, *precautionary behaviors* would attenuate the *in situ* experience of intense emotion (Campos, Frankel, & Camras, 2004) and would enable participants to experience less fear during participation (Kerr & Houge Mackenzie, 2014). As the alexithymic high-risk sport participant seeks an emotion regulation experience, he/she will likely deploy only the perceived minimum requisite *precautionary behaviors* for participation (cf. Barlow et al., 2013). Minimizing precautionary behaviors and increasing deliberate risk taking behaviors serve to increase both the unpredictability and potential for physical harm that is inherent within the activity (Merrick et al., 2004; Pickett et al., 2006; Turner, McClure, & Pirozzo, 2004); the likelihood for accidents and close calls is thus increased (see Woodman et al., 2013).

Hypothesis. Given the strong theoretical link between alexithymia and risk taking, and the established relationship between risk taking and accidents/close calls, we hypothesize that *alexithymia* will predict risk taking behaviors (both *deliberate risk taking*, positively – and *precautionary behaviors*, negatively), which in turn will lead to a greater propensity to experience accidents and close calls in the high-risk domain. Thus, the relationship between alexithymia and accidents will be mediated by *risk taking behaviors* (see Figure 1).

Study 1

Measuring accidents and close calls. Woodman et al. (2013) argued that the measurement of risk taking outcomes should not be limited to the measure of accidents. Specifically, individuals who deliberately expose themselves to danger may repeatedly experience life-threatening "close calls" yet largely avoid accidents and injury. Woodman et al. (2013) defined close calls as, "incidents that come very close to resulting in a negative outcome but that fail to materialize into a negative outcome" (p. 480). As such, close calls are largely the same as an accident except for the outcome. For example, a sizeable rock that falls from above a mountaineer and hits him/her would be considered an accident. Conversely, a sizeable rock that falls from above a mountaineer and narrowly misses him/her would be considered a close call. It can be argued that close calls (compared to accidents) are a somewhat more refined measure of the potential outcome of risk taking behaviors, as they account for other – more private – aspects of engagement. Specifically, the typical nature of a close call in the high risk domain is such that the participant is aware of its occurrence in a way that any informant or observer might not be. For example, even on a dangerous climb where a fall could be terminal, a rock climber can come very close to falling off – due to finger slipping off a crucial hold or being slightly off balance – without anyone (i.e., including his/her immediate climbing partner and especially an observer) being aware that an accident almost occurred. However, there is currently no measure of accidents and close calls

in the sport literature and *observing* accidents, and especially close calls, in the high-risk domain has practical limitations.

Consequently, to date, researchers have measured participants' accidents and close calls via recall of, for example, the mean number of annual accidents resulting in acute injuries (Woodman et al., 2013). However, such a measure is not without its limitations (van Mechelen, Hlobil, & Kemper, 1992), especially since injury and accident recall is not always very accurate, even over a 12-month period (Gabbe, Finch, Bennell, & Wajswelner, 2003). As such, we sought to develop a self-report measure of accidents and close calls in the high-risk sport domain. Although we acknowledge that self-report shares similar limitations to the recall methodology (Paulhus & Vazire, 2007) it was deemed advantageous for this line of research since it provides phenomenological data and can be administered conveniently to a large sample. Thus, one of the first aims of the present study is to propose and develop a self-report measure the Accidents and Close Calls in Sport Inventory (ACCSI).

Sensation Seeking. The main aim of Study 1 was to test the hypothesized mediation model presented in Figure 1. Additionally, we sought to ensure that the mediation model could not be discounted on the grounds of a sensation seeking explanation. This is because one could argue that risk taking behaviors might be triggered by the express aim of attaining "sensation rewards" during participation (Zuckerman, 2007, p. 13). That is, so called sensation seekers may forgo certain precautionary behaviors, and engage in deliberate risk taking behaviors, in an effort to maximize thrilling sensations while participating (see Barlow et al., 2013). Given that sensation seeking has been shown to be a significant predictor of *risk taking* and *injuries* (Kern et al., 2014), sensation seeking propensity provides a potential source of confound in the present study. As such, it was deemed necessary to control for variations in sensation seeking within the present mediation models.

Method

Participants. The original sample comprised 762 traditional rock climbers aged 18 or above. Traditional climbing refers to outdoor roped climbing where the lead climber utilizes self-placed protection in the rock to arrest any potential fall. A lack of high-risk sport experience and skill is associated with a decreased awareness of uncontrollable dangers and a decreased accuracy in differentiating risky behaviors (Celsi et al., 1993). Indeed, inexperienced participants are more likely to engage in deliberate risk taking behaviors (Ogilvie, 1974) leading to accidents and close calls (cf. Kontos, 2004). Thus, we excluded participants who reported that they were a 'beginner' or who had fewer than three years' traditional rock climbing experience (n = 49). Recruitment advertisements, placed on international rock climbing forums (e.g., ukclimbing.co.uk, rockclimbing.com, 8a.nu), led participants to a webpage providing details of the university's ethical approval, a confidentiality agreement, and a notification that proceeding to the next page was an expression of informed consent to participate. Once data screening procedures had been applied to identify spurious data (e.g., block-answering) the final sample comprised 690 individuals (598 men, 92 women; M_{age} = 32.05, SD = 11.85). Demographic data revealed a sample that was largely experienced ($M_{years' participation}$ = 11.06, SD = 7.66), competent ($M_{technical climbing ability}$ = HVS[2]), and participated frequently (frequency of participation: ≥ weekly, n = 510; ≥ twice monthly, n = 106; ≥ monthly, n = 38; ≥ every 2 months, n = 21; ≥ twice annually, n = 11; ≤ annually, n = 4).

Measures.

Toronto Alexithymia Scale (TAS-20). The TAS-20 (Bagby, Parker, & Taylor, 1994) comprises 20 items that assess three aspects of the alexithymia construct: *Difficulty identifying feelings* (e.g., I am often confused about what emotion I am feeling); *Difficulty*

[2] The British adjectival grading system for climbing was used. HVS is an abbreviation for 'Hard Very Severe' and represents an advanced level of technical ability.

describing feelings (e.g., It is difficult for me to find the right words for my feelings); *Externally oriented thoughts* (e.g., I prefer to analyze my problems rather than just describe them). Items are rated on a five-point Likert scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). The three subscales are combined to produce a *total alexithymia score* (high scores equate to high alexithymia). Parker, Taylor & Bagby (2003) reported internal reliability coefficients ranging from 0.73 to 0.84 for the total score and a sample norm mean of 45.57 (*SD* = 11.35). All reliability scores from the present study are presented in Table 2.

The Risk Taking Inventory (RTI). The RTI (Woodman et al., 2013) measures risk taking behaviors in high-risk sport and comprises seven items across two orthogonal factors: *deliberate risk taking* (e.g., I deliberately put myself in danger) and *precautionary behaviors* (e.g., I take time to check for potential hazards), measured on a five-point Likert scale ranging from 1 (*Never*) to 5 (*Always*). Woodman et al. (2013) reported composite reliability scores from 0.64 to 0.78 for *deliberate risk taking* and 0.64 to 0.71 for *precautionary behaviors*.

Accidents and Close Calls in Sport Inventory (ACCSI). The ACCSI was specifically developed for the present study (see Table 1). The initial measure comprised two proposed four-item factors: *accidents* (e.g. "My decisions in this activity lead to accidents") and *close calls* (e.g. "I experience close calls when participating in my sport") in the high-risk sport domain, measured using a seven-point Likert scale from 1 (*Never*) to 7 (*Always*).

Brief Sensation Seeking Scale (BSSS). The BSSS (Hoyle, Stephenson, Palmgreen, Pugzles, & Donohew, 2002) is a brief version of Zuckerman's (1979) Sensation Seeking Scale measuring four dimensions of sensation seeking on a five-point Likert scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). The four dimensions, each comprising two items, are: *Experience Seeking* (e.g., I would like to explore strange places); *Boredom Susceptibility* (e.g., I get restless when I spend too much time at home); *Disinhibition* (e.g., I

like wild parties); *Thrill and Adventure Seeking* (e.g., I like to do frightening things). These four dimensions are combined to provide a *total sensation seeking score*. The internal reliability coefficients range from 0.74 to 0.76 for the total score (Hoyle et al., 2002).

Procedure. Participants completed the survey online after recruitment adverts had led them to a webpage providing details of the research, a confidentiality agreement, and a notification that proceeding to the next webpage was an expression of informed consent to participate. If participants chose to continue, they completed demographic data followed by the TAS-20, RTI, ACCSI, and BSSS. The whole procedure took approximately 20 minutes.

Results

Development of the Accidents and Close Calls in Sport Inventory. The Accidents and Close Calls in Sport Inventory (ACCSI) data were analyzed using confirmatory factor analysis (CFA) partially in an exploratory fashion. Continuous variable CFA methods were deemed appropriate since the ordered-categorical data comprised seven categories (Rhemtulla, Brosseau-Liard, & Savalei, 2012). Prelis (Jöreskog & Sörbom, 2006) was used to generate a covariance matrix and Lisrel 8.8 (Jöreskog & Sörbom, 2006) was used to test the models. A model was considered a good fit to the data if the Comparative Fit Index (CFI, Bentler, 1990) and the Non-Normed Fit Index (NNFI, Tucker & Lewis, 1973) were greater than or equal to .95; the Root Mean Square Error of Approximation (RMSEA, Bentler, 1990) was less than or equal to .06; the Standardized Root Mean Square Residual (SRMR, Bentler, 1990) was less than or equal to .08; and the Satorra–Bentler (S-B) χ^2/df ratio was less than 2.00.

Initially, the proposed two-factor eight-item model was examined in order to ensure each item was a good indicator of the underlying latent variable (Jöreskog, 1993). The data fit the model adequately (*S-B* χ^2 *(19)* = 150.94; CFI = .97; NNFI = .95; RMSEA = .12; SRMR = .048; χ^2/df = 7.94). However, examination of standardized residuals, factor loadings, and

modification indices for Theta-delta revealed two items as problem residuals. Both items were a poor indicator of the underlying factor and were removed (Jöreskog, 1993), which reduced the number of items from four to three for both subscales. This removal significantly improved the fit of the model to the data, and testing the two-factor six-item full-model revealed a good fit (see Table 1) and acceptable alpha reliability levels (see Table 2). As the factor–factor correlation was moderately high (.72), we conducted a Satorra and Bentler (2001) scaled difference χ^2 test (S-B χ^2_{diff}) on the two-factor model and a respecified single-factor model. This test supported the discriminant validity of *accidents* and *close calls* factors (S-B χ^2_{diff} (1) = 94.26, $p < .001$).

Preliminary analysis. It is well established that risk taking propensity is greater in men compared to women (Byrnes, Miller, & Schafer, 1999). In the present study, no significant difference between men and woman was evidenced for *precautionary behaviors* ($t_{688} = 1.23$; $p = .11$). However, independent samples *t* test revealed that men scored significantly higher than women on *deliberate risk taking* ($t_{688} = 4.43$; $p < .001$), *close calls* ($t_{688} = 3.08$; $p < .01$), *sensation seeking* ($t_{688} = 3.80$; $p < .001$) and *alexithymia* ($t_{688} = 2.43$; $p < .01$), and the *accidents* difference approached significance ($t_{688} = 1.56$; $p = .06$). Consequently, all variables in this study, and the subsequent studies reported in this manuscript, were standardized within sexes before further analysis.

Mediation models. All mediation analyses were conducted using an SPSS macro designed and developed by Hayes (2013) using 5,000 bootstrap samples. A mediation effect was deemed significant if the upper and lower 95% Confidence Interval limits of the size of the indirect path did not include zero. In line with recommendations by Preacher and Kelley (2011) two different effect sizes are reported: the unstandardized indirect effect (*ab*) and the kappa-squared (κ^2) effect. The advantages of κ^2, detailed in Preacher and Kelley (2011), are that it is standardized, insensitive to sample size, and on an interpretable metric (0 to 1).

As hypothesized, *alexithymia* significantly predicted *deliberate risk taking* (*a* path), *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *deliberate risk taking* significantly predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3). As hypothesized, *deliberate risk taking* significantly mediated the relationship between *alexithymia* and both *accidents* and *close calls*, generating small to medium κ^2 effect sizes. The models explained 10.6% and 27.9% of the variance in *accidents* and *close calls*, respectively. Although the κ^2 analyses provided some evidence for mediation, *precautionary behaviors* largely did not significantly mediate the relationship between *alexithymia* and either *accidents* or *close calls* (see Table 3).

Sensation seeking. *Sensation seeking* was negatively correlated with *precautionary behaviors* and positively correlated with *deliberate risk taking*, *accidents*, *close calls*, and *alexithymia* (see Table 2). However, when *sensation seeking* was entered into the mediation model as a covariate, *deliberate risk taking* continued to significantly mediate the relationship between *alexithymia* and both *accidents* (*b* = .020; CI = .004-.042) and *close calls* (*b* = .037; CI = .005-.071).

Age. *Age* was significantly positively correlated with *precautionary behaviors* and significantly negatively correlated with *deliberate risk taking*, *close calls*, *alexithymia*, and *sensation seeking* (see Table 2). However, when age was entered into the mediation model as a covariate, *deliberate risk taking* continued to mediate significantly the relationship between *alexithymia* and both *accidents* (*b* = .036; CI = .014-.063) and *close calls* (*b* = .060; CI = .023-.099).

Discussion

The primary aim of Study 1 was to test the hypothesis that alexithymia would be associated with greater risk taking, which in turn would result in a greater propensity to experience accidents and close calls. Study 1 provided strong evidence for the mediating role of deliberate risk taking in the relationship between alexithymia and accidents and close calls.

Furthermore, the role of alexithymia could not be explained by sensation seeking. The role of precautionary behaviors was somewhat less clear. Certainly, the findings from Study 1 warrant replication for two principal reasons: First, there was some incongruence between the unstandardized effect and the kappa-squared (κ^2) effects for precautionary behaviors with some analyses revealing a mediation effect and others revealing no such effect (see Table 3), which requires clarification. Second, the results of Study 1 warrant extending to populations beyond rock climbers to participants of other high-risk sports. This extension is for the purposes of generalizability but also because the exclusive participation of rock climbers may have contributed to the mixed precautionary behaviors findings. Indeed, there is an element of precautionary behavior that is considered an integral part of rock climbing (e.g., checking one's harness is correctly secured prior to climbing). Thus, the aim of Study 2 was to re-examine the alexithymia and accidents/close calls relationship with a sample drawn from a variety of high-risk sports. We hypothesized that risk taking (deliberate risk taking and precautionary behaviors) would mediate this relationship.

We also sought to explore an alternative explanation for the role of alexithymia in risk taking by including anhedonia as a covariate in the mediation model. Anhedonia is the loss of self-reported pleasure and individuals high in anhedonia only feel pleasure in the most intense of hedonic environments (Volkow, Fowler, & Wang, 2003). Participants of some high-risk sports such as skydiving have been shown to demonstrate elevated anhedonia (Pierson et al., 1999). For such individuals, the experience of chronic under-arousal in everyday life may motivate them to seek sources of intense stimulation with a view to increase their arousal to a hedonic point (Eysenck & Eysenck, 1978). Purposefully seeking out intense hedonic sensations may be understood as a compensatory strategy for the anhedonic individual's basal arousal deficit (Carton, Jouvent, Bungener, & Widlöcher, 1992). In line with the sensation seeking argument presented in Study 1, anhedonic individuals may

forgo certain precautionary behaviors, and may engage in further purposeful risk taking behaviors, in an effort to maximize hedonic sensations while participating (see Franken et al., 2006). Since these risk taking behaviors would likely also lead to an increased incidence of both accidents and close calls, anhedonia provides a potential source of confound in the previous analyses. Although they are conceptually distinct, anhedonia and alexithymia have a degree of commonality insomuch as they reflect a state of emotion dysregulation (Loas, Fremaux, & Boyer, 1997). Given the strong theoretical link between anhedonia and alexithymia and between anhedonia and risk-taking, we aimed to test whether the alexithymia – risk-taking relationship would hold when controlling for anhedonia in the present mediation model.

Study 2

Method

Participants. The sample comprised 332 new participants. Checking the email addresses of all participants across all three studies revealed that participants across the three studies participated in one study and in one study only. In the present study participants engaged in a variety of high-risk sports (e.g., downhill mountain biking, rock climbing, sky diving, white water kayaking) and were recruited via internet advertisements placed on international sporting forums (e.g., dropzone.com, newschoolers.com). The inclusion criteria (i.e., minimum of 18 years of age, a minimum of 3 years' participation in the individual's main high-risk sport and not self-classified as a beginner) mirrored those of Study 1. Data screening, as used in Study 1, removed five participants. The final sample comprised 327 individuals (292 men, 35 women; M_{age} = 35.43, SD = 12.92). Demographic data revealed that participants were largely experienced ($M_{years' participation}$ = 15.74, SD = 11.22), competent (intermediate, n = 49; advanced, n = 166; expert, n = 112) and regularly engaged in their

chosen high-risk sport (frequency of participation: ≥ weekly, $n = 183$; ≥ twice monthly, $n = 84$; ≥ monthly, $n = 39$; ≥ every 2 months, $n = 13$; ≥ twice annually, $n = 7$; ≤ annually, $n = 1$).

Measures. We administered the RTI, TAS-20, and ACCSI, as in Study 1.

Snaith-Hamilton Anhedonia Pleasure Scale (SHAPS). The SHAPS (Snaith et al., 1995) was produced to assess an individual's hedonic capacity using 14 items concerning a variety of subjects: hobbies, family, appearance and food/drink (e.g., *"I would find pleasure in my hobbies and past times"*). Responses were scored on a four-point Likert scale from 1 (*Strongly agree*) to 4 (*Strongly disagree*) with high scores representing high levels of anhedonia. Nakonezny, Carmody, Morris, Kurian, and Trivedi (2010) reported an alpha reliability coefficient of 0.91.

Procedure. The online presentation of the inventories mimicked that of Study 1, with the additional inclusion of the SHAPS, and took approximately 25 minutes to complete.

Results

ACCSI model fit. An adequate fit for the two-factor, six-item ACCSI model was confirmed (see Table 1). The factor–factor correlation was .87. Satorra–Bentler scaled difference χ^2 test again supported the discriminant validity of the two factors (S-B $\chi^2_{diff}(1) = 10.90$, $p < .001$).

Mediation models. As hypothesized, and confirming the findings from Study 1, *deliberate risk taking* significantly mediated the relationship between *alexithymia* and both *accidents* and *close calls* (see Table 3), generating small to medium κ^2 effect sizes. The models explained 18.0% and 26.4% of the variance in accidents and close calls, respectively. As expected, *alexithymia* significantly positively predicted *deliberate risk taking* (*a* path), *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *deliberate risk taking* significantly positively predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3).

As hypothesized, and clarifying the ambiguous finding in Study 1, *precautionary behaviors* significantly mediated the relationship between *alexithymia* and both *accidents* and *close calls* although the generated κ^2 effect sizes were small. The models explained 8.9% and 8.8% of the variance in *accidents* and *close calls*, respectively. As expected, *alexithymia* significantly negatively predicted *precautionary behaviors* (*a* path), and positively predicted *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *precautionary behaviors* significantly negatively predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3).

Anhedonia. Anhedonia significantly positively correlated with *alexithymia* and significantly negatively correlated with *precautionary behaviors*. Anhedonia was not significantly correlated with either *deliberate risk taking*, *accidents*, or *close calls* (see Table 2). When *anhedonia* was entered into the mediation model as a covariate, *deliberate risk taking* continued to significantly mediate the relationship between *alexithymia* and both *accidents* (*b* = .081, CI = .038-.140) and *close calls* (*b* = .103, CI = .049-.168). Additionally, *precautionary behaviors* continued to significantly mediate the relationship between *alexithymia* and both *accidents* (*b* = .025; CI = .002-.072) and *close calls* (*b* = .023; CI = .003-.060).

Discussion

As hypothesized, both deliberate risk taking and precautionary behaviors emerged as significant mediators in the relationship between alexithymia and accidents/close calls. Clarifying the results from Study 1, this mediation effect was consistent across the unstandardized and kappa-squared effects. Anhedonia did not significantly reduce the mediating effect of either deliberate risk taking or precautionary behaviors in the relationship between alexithymia and accidents/close calls. Given the degree of ambiguity of the results in Study 1 and the clarity of the results in Study 2, the aim of Study 3 is to confirm the alexithymia – risk taking – accidents/close calls model.

Study 3

Method

Participants. The sample comprised 356 new participants. As in Study 2, participants engaged in a variety of high-risk sports (e.g., hang gliding, mountaineering, surfing) and were recruited using internet adverts on major international sporting fora. Data screening, as used in Study 1 and Study 2, removed 15 participants. The final sample comprised 341 individuals (271 men, 70 women; M_{age} = 37.10, *SD* = 14.20; $M_{years' participation}$ = 12.70, *SD* = 11.90). Demographic data revealed that participants' experience, ability, and frequency of participation in their chosen sport, closely resembled those revealed in Study 2.

Measures and procedures. The procedure was the same as in Study 2.

Results

ACCSI model fit. A good fit for the two-factor, six-item ACCSI model was further confirmed (see Table 1). The factor–factor correlation was .85. Satorra–Bentler scaled difference χ^2 test again supported the discriminant validity of the two factors (S-B χ^2_{diff} (1) = 32.55, $p < .001$).

Mediation models. *Deliberate risk taking* significantly mediated the relationship between *alexithymia* and both *accidents* and *close calls* (see Table 3), generating medium κ^2 effect sizes. The models explained 32.4% and 45.0% of the variance in accidents and close calls, respectively. As expected, *alexithymia* significantly positively predicted *deliberate risk taking* (*a* path), *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *deliberate risk taking* significantly positively predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3).

Confirming the finding in Study 2, and in line with the hypothesis, *precautionary behaviors* significantly mediated the relationship between *alexithymia* and both *accidents* and *close calls*, generating small κ^2 effect sizes. The models explained 16.5% and 20.3% of the

variance in *accidents* and *close calls*, respectively. As expected, *alexithymia* significantly negatively predicted *precautionary behaviors* (*a* path), and positively predicted *accidents* (*c'* path), and *close calls* (*c'* path). Additionally, *precautionary behaviors* significantly negatively predicted *accidents* (*b* path) and *close calls* (*b* path; see Table 3).

Anhedonia. As in Study 2, *anhedonia* was significantly negatively correlated with *precautionary behaviors* and significantly positively correlated with *alexithymia*. Again, no significant correlation was revealed for either *deliberate risk taking* or *close calls* although, in the present study, *anhedonia* was significantly correlated with *accidents* (see Table 2). Confirming the Study 2 finding, when *anhedonia* was entered into the mediation model as a covariate, *deliberate risk taking* continued to mediate significantly the relationship between *alexithymia* and both *accidents* (*b* = .159, CI = .010-.231) and *close calls* (*b* = .189, CI = .124-.293). Additionally, *precautionary behaviors* continued to mediate significantly the relationship between *alexithymia* and both *accidents* (*b* = .080; CI = .036-.153) and *close calls* (*b* = .084; CI = .041-.144).

Discussion

As in Study 2 both deliberate risk taking and precautionary behaviors emerged as significant mediators of the relationship between alexithymia and accidents/close calls. Additionally, the models could not be explained by anhedonia.

General Discussion

The aim of the present studies was to test the relationship between alexithymia, risk taking, and accidents and close calls. Results consistently revealed that both deliberate risk taking and precautionary behaviors mediated the alexithymia – accidents/close calls relationship. Furthermore, we developed a two-factor measure of accidents and close calls in sport, which consistently fit the data well and evidenced preliminary concurrent validity.

Unlike merely observing correlations between variables, the present mediation analyses enable tentative causal inferences to be made (Preacher & Hayes, 2008). Specifically, one could argue that the present results provide support for alexithymia causally influencing risk taking behaviors, which in turn lead to the incidence of accidents and close calls. The direction of this sequential pathway is made all the more likely by the nature of the independent variable because alexithymia is widely considered a stable personality trait (e.g., Bagby et al., 1994; Luminet et al., 2007). However, more research is required before this theoretically derived sequential position can be validated, as even stable personality traits are not set in stone (Roberts, Walton, & Viechtbauer, 2006). Although a definitive conclusion regarding causation would be premature, the alternative explanations are theoretically more tenuous. Specifically, it is difficult to contend theoretically that risk taking, or indeed the experience of accidents within a high-risk domain, would lead to elevated alexithymia. Furthermore, it would be equally contentious to argue theoretically that the experience of accidents in the high-risk domain might result in an increase in risk taking behaviors. Rather, one would more easily argue for the opposite effect, as the experience of an accident would likely decrease, not increase, the propensity to take risks (regardless of alexithymia). Despite the strength of the theoretical position regarding the sequence of the mediation model, there remains a need for further research to confirm (or otherwise) that position.

As discussed previously, it could be argued that it is either sensation seeking or anhedonia that lead to greater risk taking behaviors in the high-risk domain. Indeed, both sensation seeking (Study 1) and anhedonia (Study 2 and Study 3) are associated with decreased precautionary behaviors, and sensation seeking is associated with increased deliberate risk taking. However, the present analyses suggest that such an argument would be ill-founded, as it was indeed alexithymia that consistently emerged a significant predictor of risk taking behaviors when controlling for both sensation seeking and anhedonia. That being

said, future research would do well to explore additional variables that may significantly contribute to the present mediation model (e.g., escape from self-awareness; Castanier et al., 2011; Taylor & Hamilton, 1997).

Across the three studies, both the deliberate risk taking and precautionary behavior mediation models demonstrated small to medium effect sizes with both accidents and close calls. We prefer to avoid an inflexible interpretation of effect size based solely on arbitrary benchmarks (cf. Preacher & Kelley, 2011) and rather prefer to emphasize that the relatively modest effect sizes may have substantive practical importance. Specifically, in the context of dangerous environments, people will die if they enter the high-risk sport domain and completely fail to display any precautionary behaviors whilst simultaneously maximizing deliberate risk taking behaviors. In other words, it can be argued here that small effect sizes could have very meaningful real-life connotations.

The clear relationship between alexithymia and accidents/close calls has considerable practical implications with regard to accident and injury prevention, which is a growing area of research given the escalation of litigation costs associated with injuries (Hébert-Losier & Holmberg, 2013). Indeed, the use of alexithymia as a construct to predict risk taking behaviors could be useful in the identification of potentially dangerous participants - dangerous to themselves, to other participants, or both. It is indeed likely that most instructors and group leaders would welcome any such information when preparing participants for their activity. However, further research is required to establish if the alexithymia – risk-taking relationship might be extended beyond the population of experienced, competent, and adult high-risk sport participants studied in the present study. As the high-risk sport participants' group-mean levels of alexithymia were comparable to those of Parker et al.'s (2003) sample norms, it would be worth testing whether the present model could be extended to other risk-

taking domains within sport and exercise (e.g., drug taking, overtraining) or indeed to risk taking environments beyond sport (e.g., industrial and financial risks, crime).

The present theoretical framework suggests that the alexithymic individual actively seeks out intense emotion, such as fear, via the high-risk domain. Of course, individuals may actively initiate, experience, and subsequently control intense emotion such as fear (Fenichel, 1939; Woodman et al., 2010) such that fear is not actively experienced to any great degree during the activity. Indeed, research suggests that certain high-risk sport participants perceive they can control their fear in the high-risk domain (Barlow et al., 2013; Celsi et al., 1993); even experiencing a perceived temporary "freedom from fear" (Lester, 2004, p. 91). This is evidenced by Laberge[3] (1993), a specialist solo[4] rock climber, who said, "While climbing solo, you experience moments of intense stress and you manage to dominate them" (p. 33).

Previous research (e.g., Barlow et al., 2013; Woodman et al., 2010) has proposed that participation in high-risk sport may offer an adaptive form of compensation for individuals with emotional difficulties. That is, such participation might be deemed emotionally adaptive compared to relatively destructive behavioral patterns such as substance abuse (Pierson et al., 1999). However, the present findings suggest that such a dichotomous adaptive-maladaptive categorization may be somewhat simplistic. Indeed, the data consistently revealed that alexithymia leads to a greater vulnerability to *maladaptive* outcomes – accidents – in what has previously been considered an *adaptive* activity. Any adaptive outcome may be experienced in the form of an emotion regulation benefit transferred from the high-risk domain back into everyday life (Barlow et al., 2013). Specifically, the perceived ability to deal effectively with the intense emotions in the high-risk domain (e.g., fear) may provide the alexithymic individual with an enhanced, albeit temporary, sense of emotion regulation in

[3] We are not suggesting that Laberge is an alexithymic individual.
[4] Rock climbing without the protection of a rope.

everyday life following the activity (Barlow et al., 2013; Woodman et al., 2009). Any such benefits are of course likely enjoyed only to the extent that the person survives any misdemeanors in the high-risk domain. In the specific context of the high-risk domain, particularly for those with emotional difficulties, Nietzsche (1889/1998) was very probably quite correct: "whatever does not kill me makes me stronger" (p. 58).

It could be argued that a limitation of the present studies is the self-report nature of the ACCSI. That is, participants' responses may have suffered from biases, such as a self-deception bias or an impression management bias (Gravetter & Forzano, 2012). Previous research suggests that such inherent weaknesses of self-report methods may be somewhat attenuated in the present sample. Specifically, high-risk sport participants do not significantly differ from controls regarding impression management (Barlow et al., 2013) and their self-report responses, pertaining to their own risk taking behaviors, significantly correlate with the same self-report measures from an informant (Woodman et al., 2013). Furthermore, that the ACCSI consistently showed good model-fit across three studies considerably mitigates this limitation. We argue that a primary advantage of employing a self-report inventory is that each individual – even an individual with emotional regulation difficulties – is in a unique position of self-knowledge and self-awareness (Gravetter & Forzano, 2012). An alternative method would have been to ask participants to recall their accidents and close calls in a retrospective design. However, such methods are also reliant on self-report and are not always very accurate even over a 12-month period (Gabbe et al., 2003). Thus, recording accidents and close calls in a prospective design, with the use of diary data for example, would somewhat mitigate this limitation and is therefore an important direction for future research.

In summary, the present set of studies demonstrates that alexithymia leads to a propensity to adopt greater risk taking behaviors, which in turn increases the likelihood of an

accident or a close call in the high-risk domain. The alexithymic individual may deem the risk of physical harm as an acceptable – or indeed necessary – evil to derive the emotion regulation benefit that is craved in the high-risk domain, and we urge researchers to consider more fully and widely the emotion regulation motives that might be associated with risk taking in sport and exercise environments more globally.

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Table 1.

Item-factor loadings and full-model fit indices for the Accidents and Close Calls in Sport Inventory (ACCSI) in Study 1, Study 2 and Study 3.

Accidents and Close Calls in Sport Inventory	Study 1	Study 2	Study 3
Close Calls			
(1) I experience close calls when participating in my sport	.80	.81	.88
(3) I find myself in situations that lead to near misses	.85	.85	.91
(5) During participation in my sport I narrowly avoid accidents	.77	.72	.81
Accidents			
(2) I am involved in accidents when participating in my sport	.84	.82	.90
(4) My decisions in this activity lead to accidents	.70	.77	.72
(6) I sustain injuries as a result of accidents	.68	.71	.72
Two-factor full-model fit indices			
S-B χ^2 *(13)*	18.18	38.99	21.14
CFI	.99	.98	.99
NNFI	.99	.98	.99
RMSEA	.04	.12	.09
SRMR	.03	.04	.03
χ^2/df	2.27	4.87	2.64

Note: The wording for the item stem was “Please respond concerning your common experiences in high-risk sport”. Item numbers (in parentheses) represent the item-order that was presented to the participants. *S-B* = Satorra-Bentler; CFI = Comparative Fit Index; NNFI = Non-Normed Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Residual.

Table 2.

Correlations between alexithymia, deliberate risk taking, precautionary behaviors, accidents, close calls, sensation seeking, and anhedonia in Study 1, Study 2, and Study 3.

		Deliberate risk taking	Precautionary behaviors	Alexithymia	Accidents	Close calls	Sensation seeking	Anhedonia	Age
		.65	-.12***	.15***	.31***	.52***	.45***	-	-.21***
1	Deliberate risk taking	.72	-.12**	.22***	.40***	.49***	-	.02	-.20***
		.80	-.34***	.31***	.54***	.64***	-	.06	-.19***
			.72	-.23***	-.02	-.10**	-.20***	-	.16***
2	Precautionary behaviors		.81	-.16***	-.22***	-.20***	-	-.18***	.13*
			.79	-.33***	-.33***	-.34***	-	-.14***	.14**
				.81	.15***	.19***	.15***	-	-.14***
3	Alexithymia			.85	.24***	.26***	-	.25***	-.19***
				.84	.33***	.38***	-	.30***	-.18***
					.79	.59***	.23***	-	-.06
4	Accidents				.81	.73***	-	.01	-.16**
					.86	.79***	-	.18**	-.10**
						.85	.31***	-	-.14***
5	Close calls					.83	-	.03	-.11*
						.90	-	.06	-.16**
							.76	-	-.39***
6	Sensation seeking						-	-	-
							-	-	-
								-	-
7	Anhedonia							.88	-.05
								.91	-.07
									-
8	Age								-
									-
		7.29 (2.22)	15.88 (2.64)	47.35 (10.15)	6.06 (2.22)	11.00 (3.64)	29.04 (5.28)	-	32.05 (11.85)
	Mean (SD)	6.93 (2.58)	17.24 (2.92)	48.18 (10.76)	6.93 (2.70)	10.20 (3.96)	-	23.80 (5.46)	35.43 (12.92)
		7.23 (3.03)	16.92 (2.88)	44.76 (11.18)	6.93 (2.91)	11.48 (4.28)	-	22.40 (6.16)	37.10 (14.20)

Note: A maximum of three values are presented in each cell of the table: Top = Study 1; Middle = Study 2; Bottom = Study 3. Where no value is present, indicated by a dash, this relationship was not measured in the particular study. Deliberate risk taking and precautionary behaviors = factor scores on Woodman et al.'s (2013) Risk Taking Inventory; Alexithymia = total score on Bagby et al.'s (1994) Toronto Alexithymia Scale 20; Accidents and Close calls = factor total scores on the new Accidents and Close Calls Inventory; Sensation seeking = total score on Hoyle et al.'s (2002) Brief Sensation Seeking Scale; Anhedonia = total score on Snaith et al.'s (1995) Snaith-Hamilton Anhedonia Pleasure Scale. Coefficient alphas are on the diagonal.

*$p < .05$, **$p < .01$, ***$p < .001$

Table 3.

The relationship between Alexithymia and accidents and close calls as mediated by risk taking behaviors in Study 1, Study 2 and Study 3.

			Indirect effect			*Kappa squared*			*a* path		*b* path		*c'* path	
	M	Y	*b*	LLCI	ULCI	κ^2	LLCI	ULCI	*b*	*t*	*b*	*t*	*b*	*t*
Study 1	DRT	Accidents	.04	.021	.071	.04	.020	.070	.15	3.86***	.29	8.04***	.10	2.83**
	DRT	Close calls	.07	.035	.115	.08	.038	.120	.15	3.86***	.50	15.29***	.11	3.45***
	PB	Accidents	-.00	-.022	.016	.00	.000	.009	-.23	-6.13***	.01	.31	.15	3.84***
	PB	Close calls	.01	-.005	.035	.01	.001	.035	-.23	-6.13***	-.06	-1.51	.17	4.49***
Study 2	DRT	Accidents	.08	.036	.134	.08	.037	.129	.21	3.96***	.36	7.02***	.16	3.08**
	DRT	Close calls	.10	.046	.160	.10	.048	.162	.21	3.96***	.46	9.49***	.15	2.98**
	PB	Accidents	.03	.004	.083	.03	.005	.080	-.16	-2.98**	-.18	-3.43***	.21	3.83***
	PB	Close calls	.03	.006	.069	.03	.006	.068	-.16	-2.98**	-.17	-3.14**	.22	4.03***
Study 3	DRT	Accidents	.15	.093	.220	.16	.100	.219	.31	6.07***	.49	10.37***	.18	3.75***
	DRT	Close calls	.18	.114	.259	.20	.125	.267	.31	6.07***	.58	13.72***	.19	4.59***
	PB	Accidents	.08	.037	.157	.08	.040	.151	-.33	-6.49***	-.25	-4.79***	.25	4.66***
	PB	Close calls	.09	.043	.152	.09	.046	.148	-.33	-6.49***	-.26	-5.07***	.29	5.65***

Note: M = Mediator; Y = Outcome variable; *b* = Unstandardized beta coefficient; LLCI = Lower limit confidence interval; ULCI = Upper limit confidence interval; κ^2 = Kappa squared; *a* path = predictor variable to mediator variable; *b* path = mediator variable to outcome variable; *c'* path = direct effect; DRT = Deliberate risk taking on Woodman et al.'s (2013) Risk Taking Inventory; PB = Precautionary behaviors on Woodman et al.'s (2013) Risk Taking Inventory; Accidents and Close calls = factor total scores on the new Accidents and Close Calls Inventory.
*$p < .05$
**$p < .01$
***$p < .001$

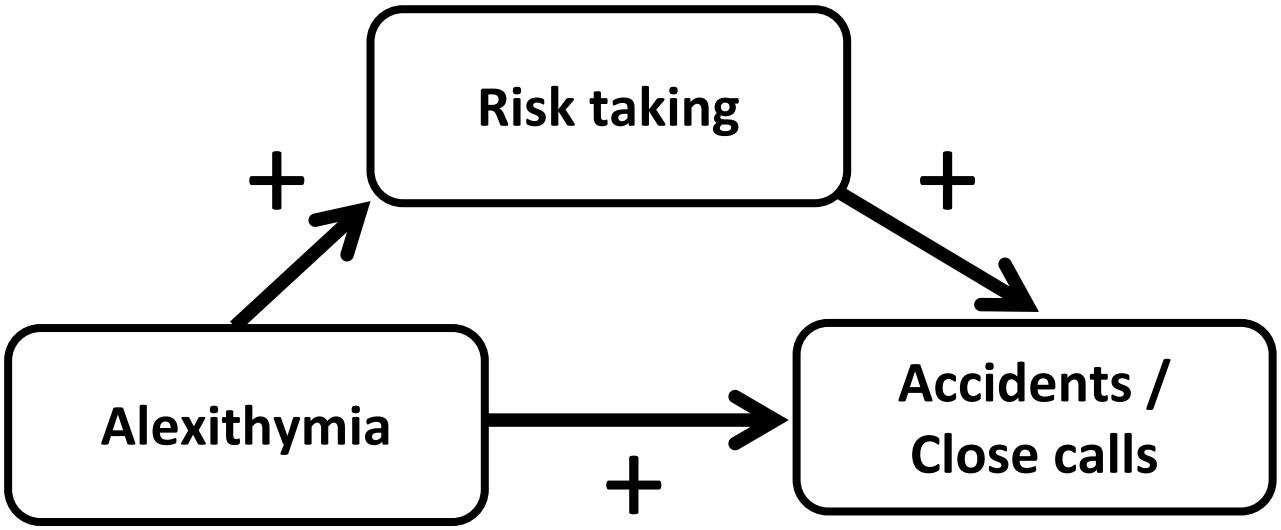

Figure 1. The mediating role of risk taking in the alexithymia – accidents/close calls relationship.